

Combining satellite data, surface aerosol measurements and dispersion modeling for characterization of air pollution episode during Grimsvötn volcanic eruption

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Grimsvötn/Iceland eruption 21.5 2011



Lähde: Iltalehden verkkos



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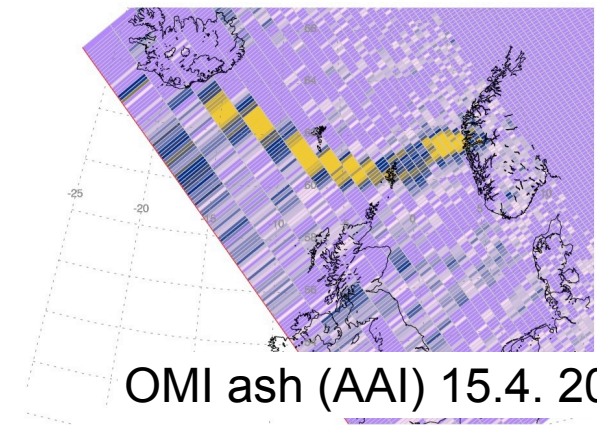
Eyjafjallajökull eruption April/May 2010

The European air traffic was partly closed for almost one week starting on 15.4

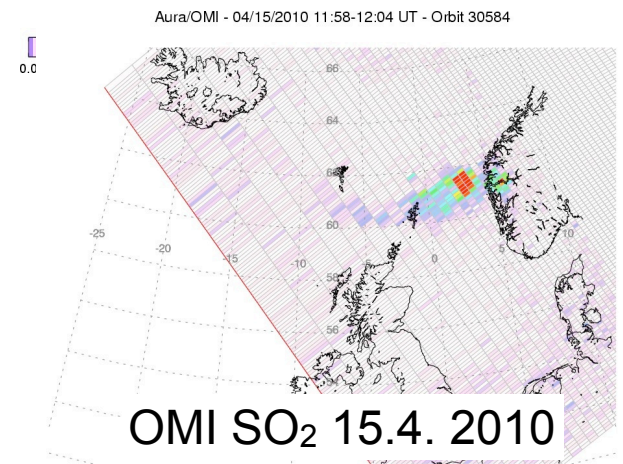
- Transport of the ash is forecasted using dispersion models.
- Measurements needed to calibrate the source term for models and for model verification
- OMI measurements used:
 - ash (absorbing aerosol index, AAI)
 - SO₂



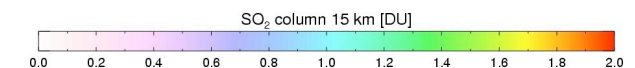
Aura/OMI - 04/15/2010 11:58-12:04 UT - Orbit 30584



OMI ash (AAI) 15.4. 2010



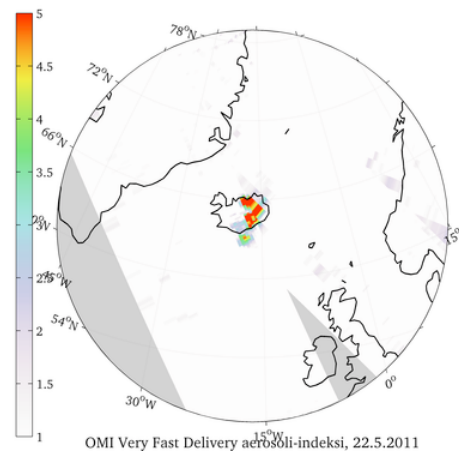
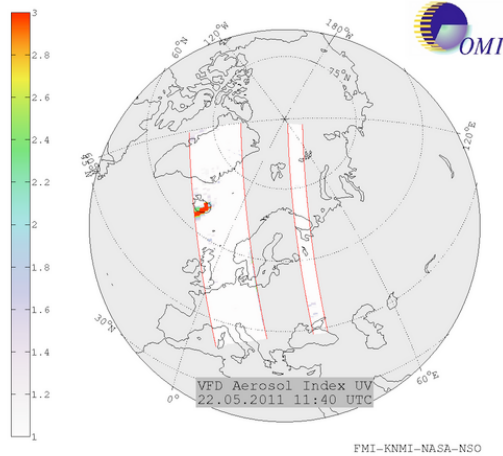
OMI SO₂ 15.4. 2010





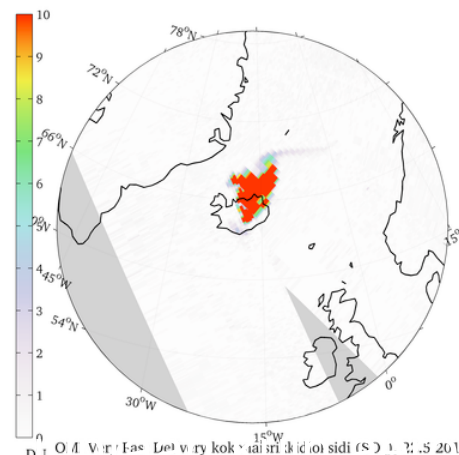
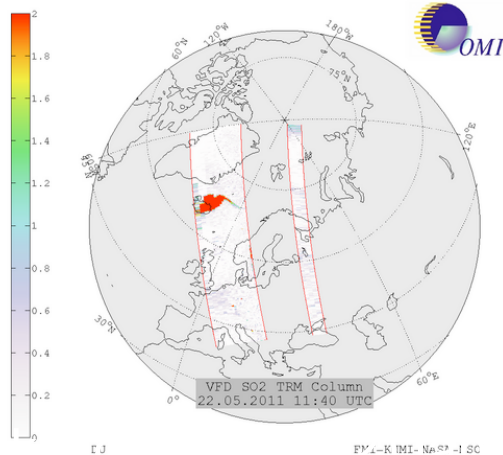
OMI VFD images of Grimsvötn eruption 22.5.2011

AAI:



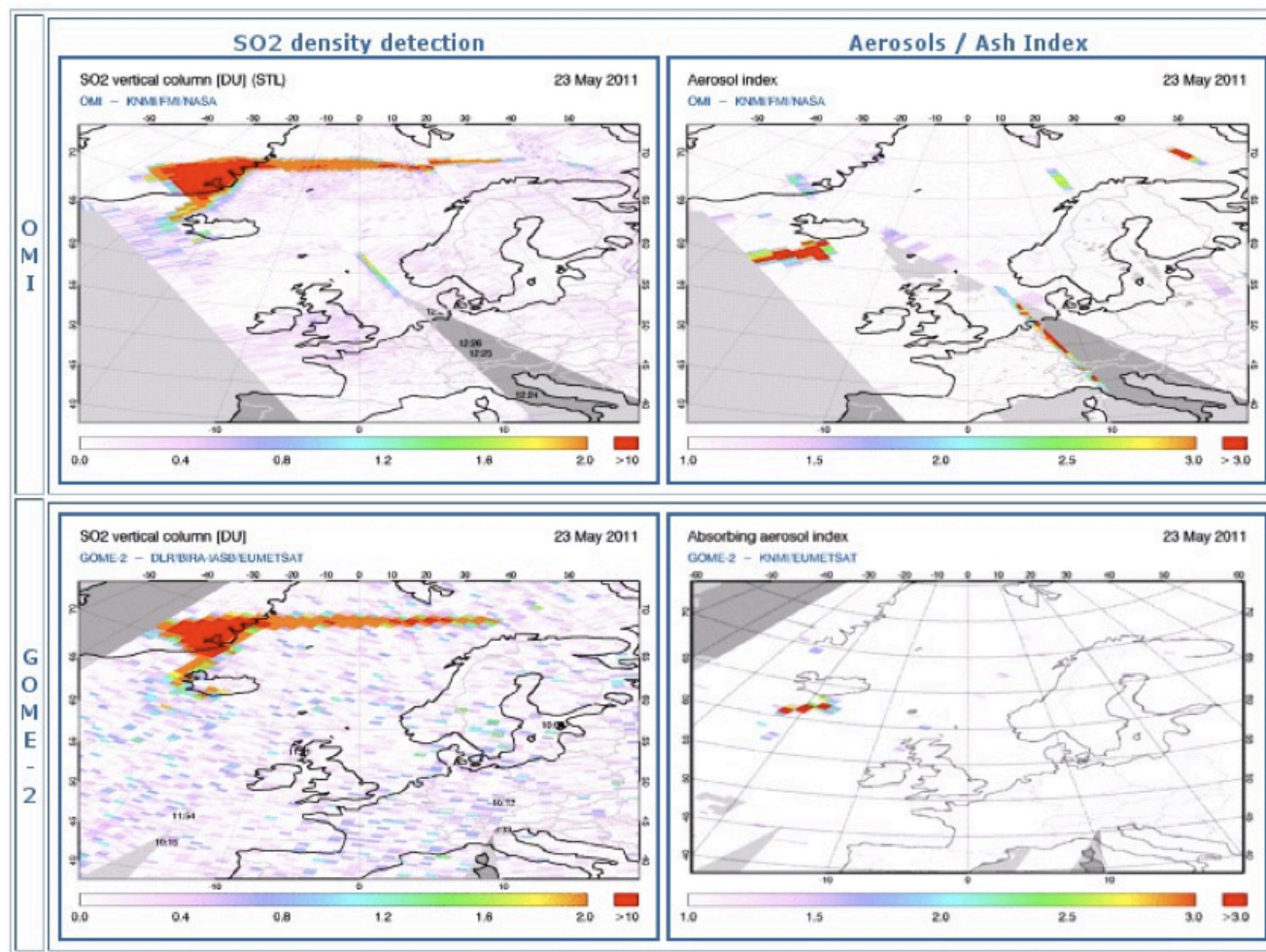
- The separation of volcanic ash and SO_2 after the eruption is observed in OMI data
- Separation might be caused by potential differences in the timing and ejection heights of SO_2 and ash particles emissions, or by the sedimentation of ash particles from the dispersing plume.

SO_2 :



GOME-2 and OMI on May 23

- Good agreement in GOME-2 and OMI AAI and SO₂ measurements
- Separation of SO₂ and ash clearly visible



Top row OMI SO₂ and AAI

Bottom GOME-2 SO₂ and AAI



Silam dispersion model forecast

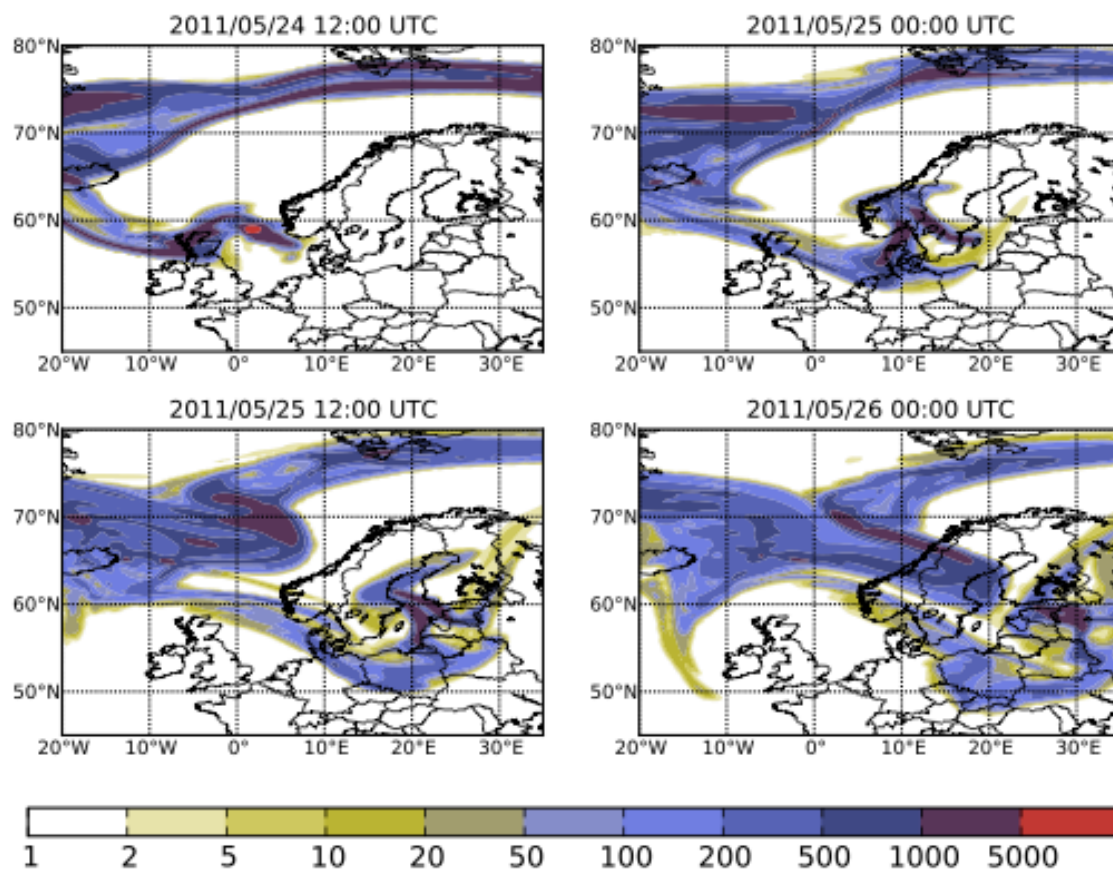
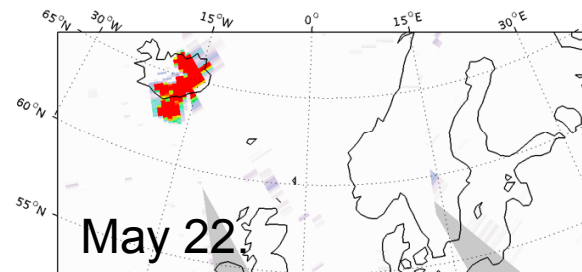
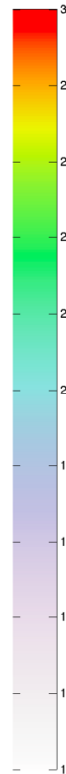


Fig. 4. The SILAM dispersion model results for the column-integrated volcanic ash concentration (mg m^{-2}) during 24–25 May 2011.

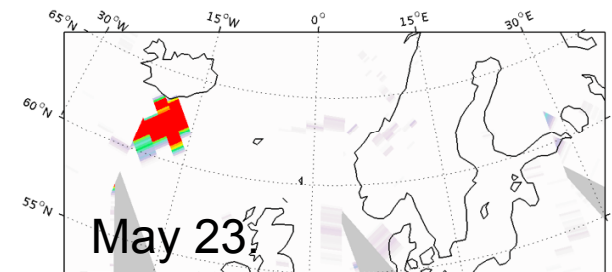


Dispersion of ash

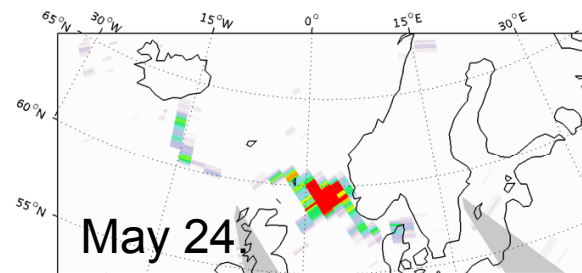
- The eruption of Grimsvötn started on 21 May, was at its strongest on 22 May, and then rapidly weakened during the next few days.
- In OMI data we see high AAI values over Iceland on 22 May and similarly high values South of Iceland in the following day.
- On May 23 the ash is close to Norwegian coast and on 25th it arrives to Southern Finland and Estonia.



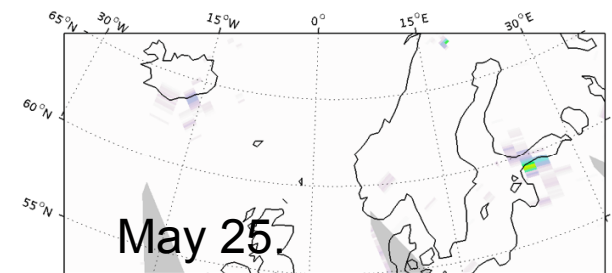
OMI AAI, 22.5.2011



OMI AAI, 23.5.2011



OMI AAI, 24.5.2011



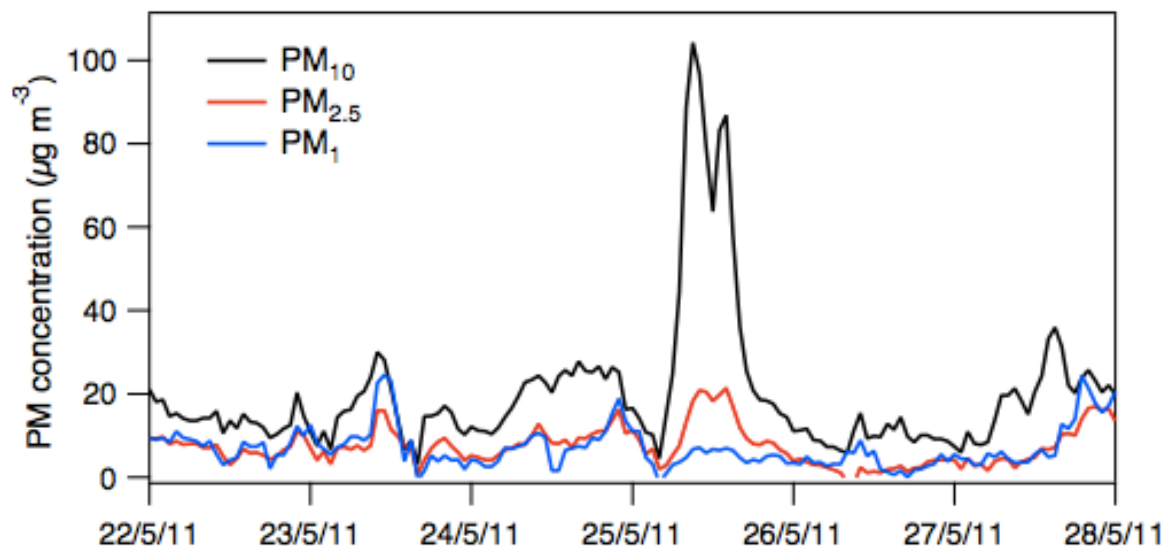
OMI AAI, 25.5.2011

OMI AAI index during four days



Characterizing the pollution episode

- **Increased PM₁₀ values clear on May 25th**
- **Concentration of smaller particles not increased**

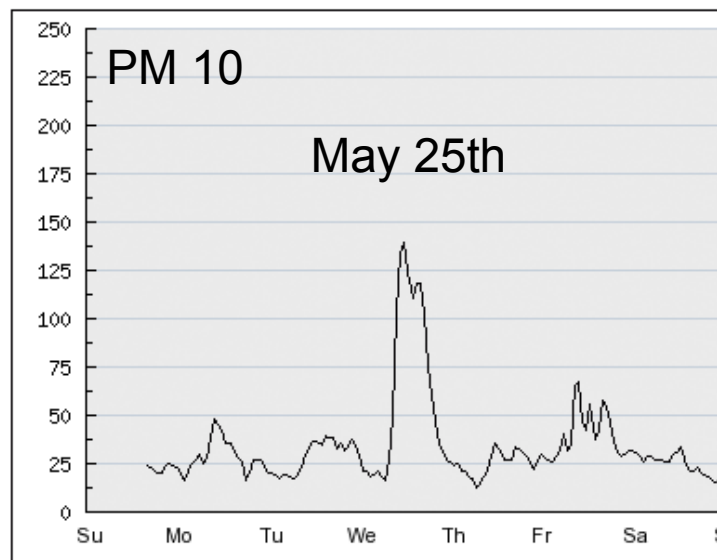
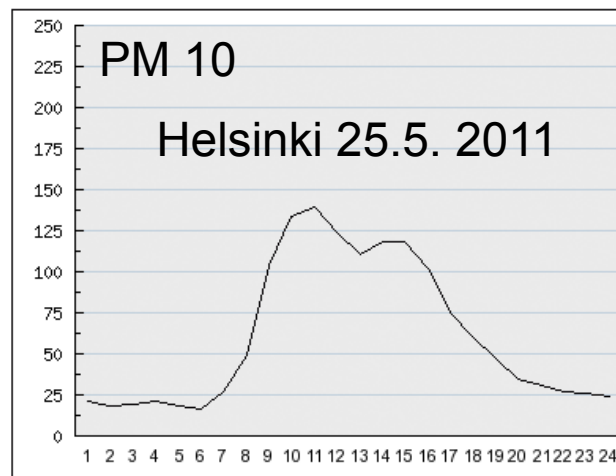
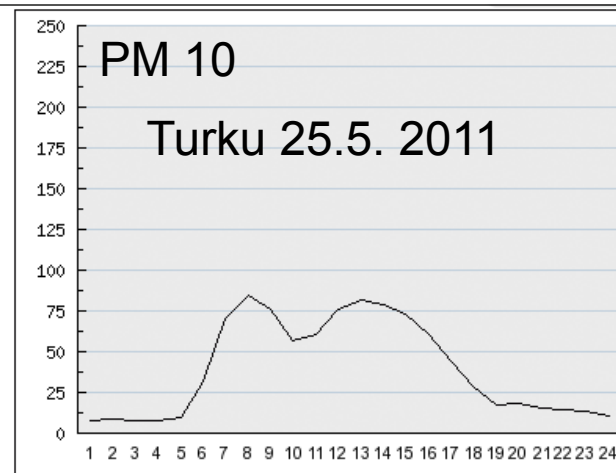


Mass concentration ($\mu\text{g m}^{-3}$) of particulate matter in Helsinki May 22-28, 2011.

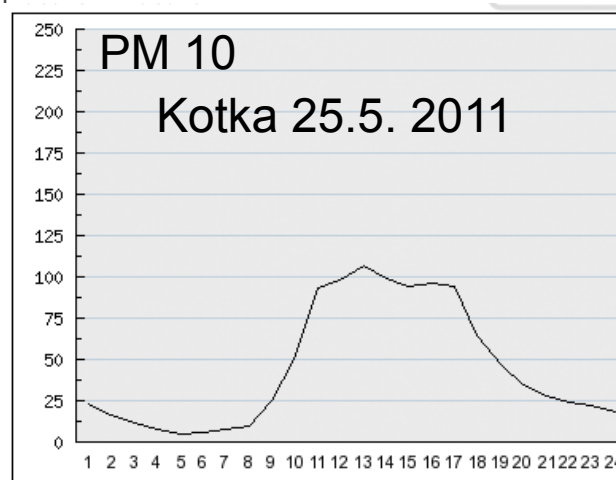


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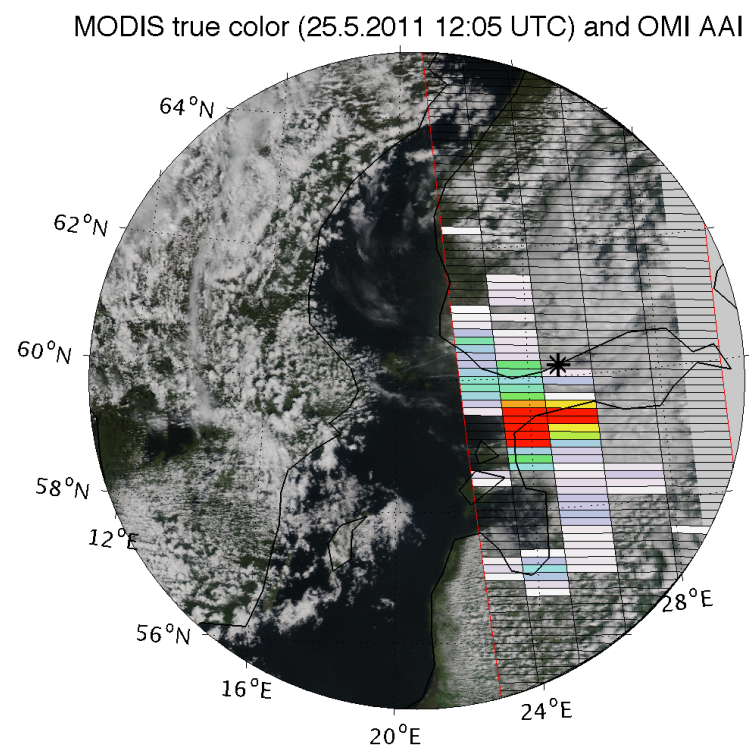
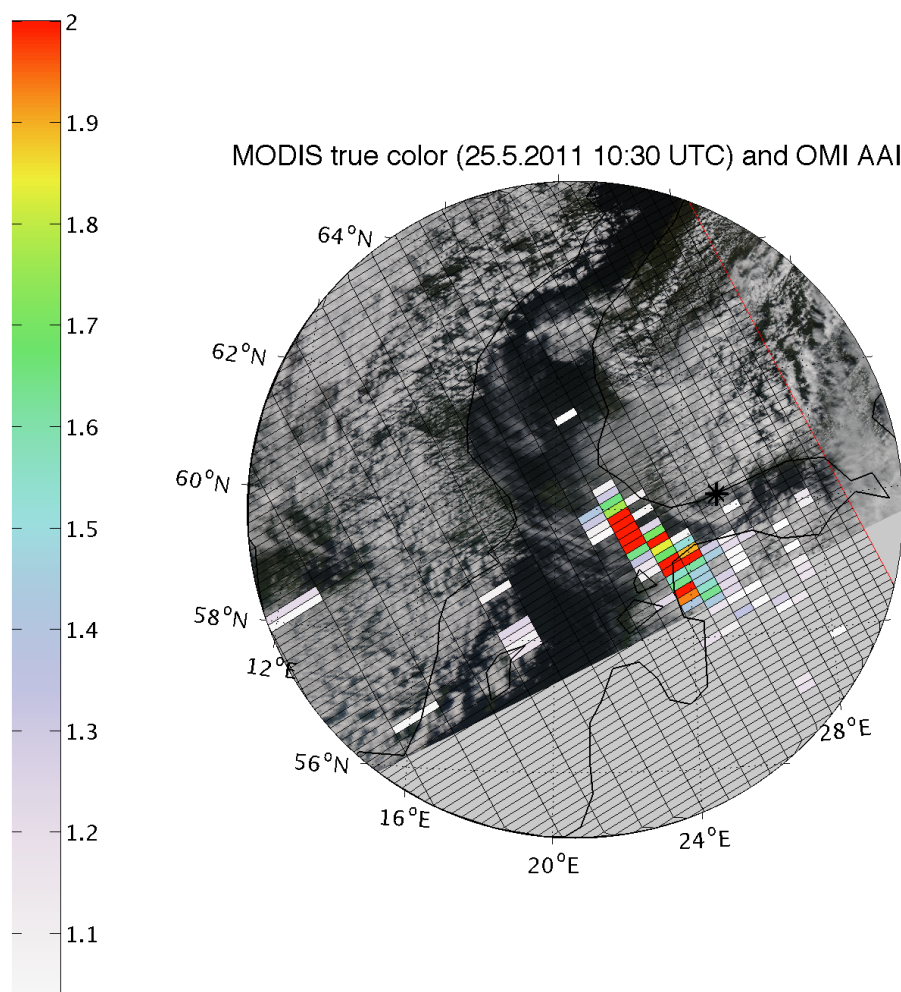
- The air quality decreases in the Southern Finland for about 8 hours.
- The highest PM10 values in Helsinki were observed around noon
- Annual average of PM10 in Helsinki area is about $20 \mu\text{g m}^{-3}$



Mass concentration ($\mu\text{g m}^{-3}$) of particulate matter

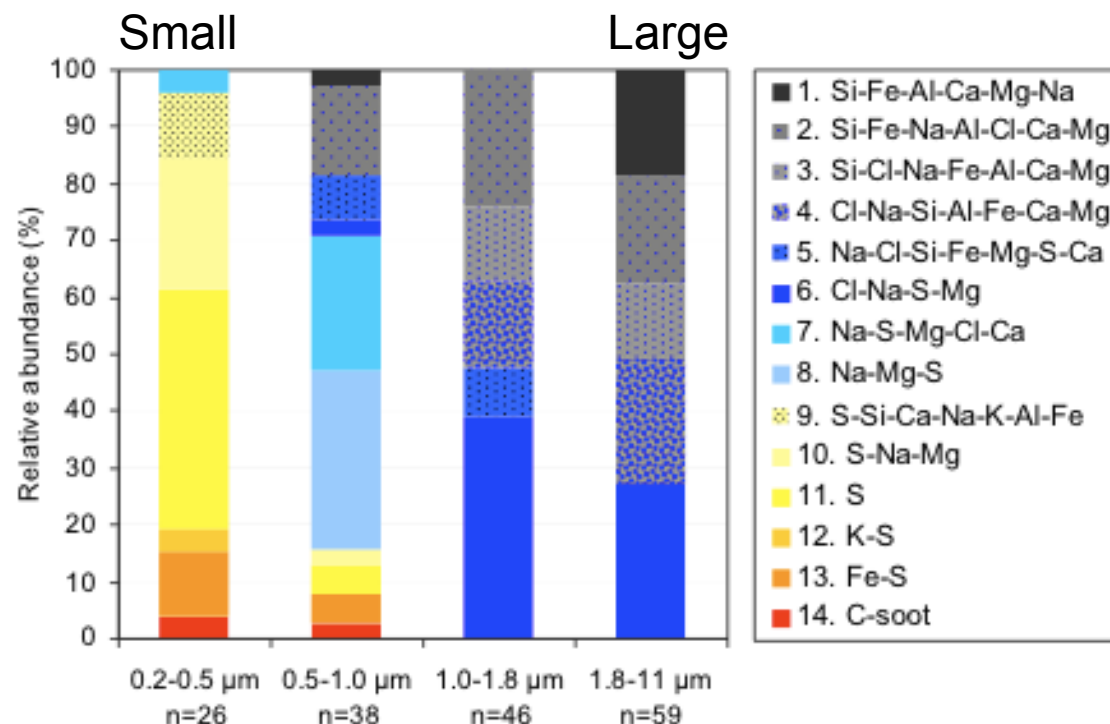


OMI AAI on two successive orbits above southern Finland





Particle analysis



Volcanic ash

Ash mixed with sea salt

Sea salt

Secondary particles

**Combustion derived
primary particles**

- 193 particles collected
- Transmission electron microscope / x-ray fluorescence (TEM/EDX) used to analyse individual particles in Helsinki
- Comparison with Grimsvötn volcanic ash fallout measured in Iceland confirmed that volcanic ash was measured in Helsinki
- In large size group mainly volcanic ash and ash mixed with sea salt
- Only very little sulfate was observed

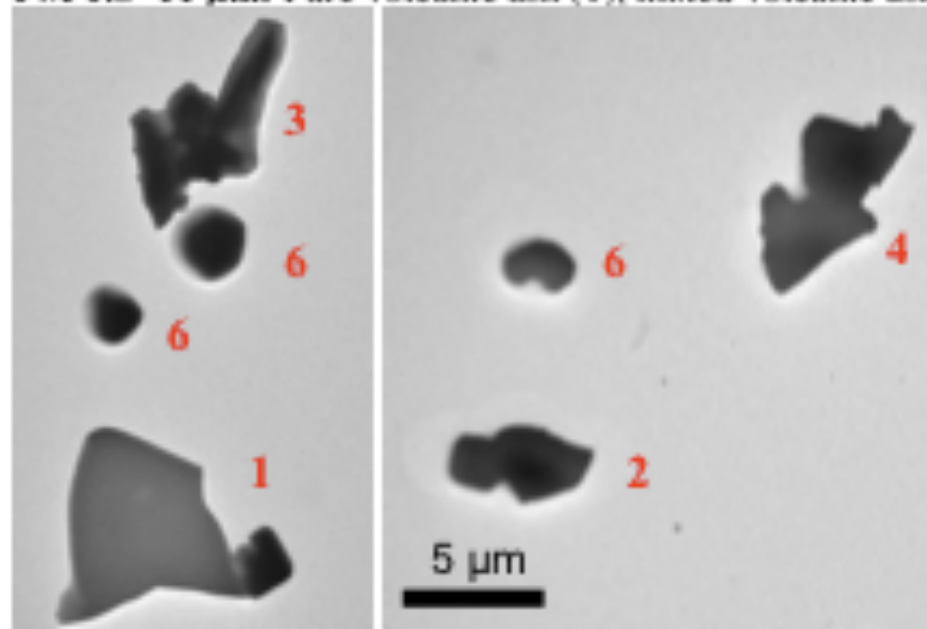
Particles measured

1 ash

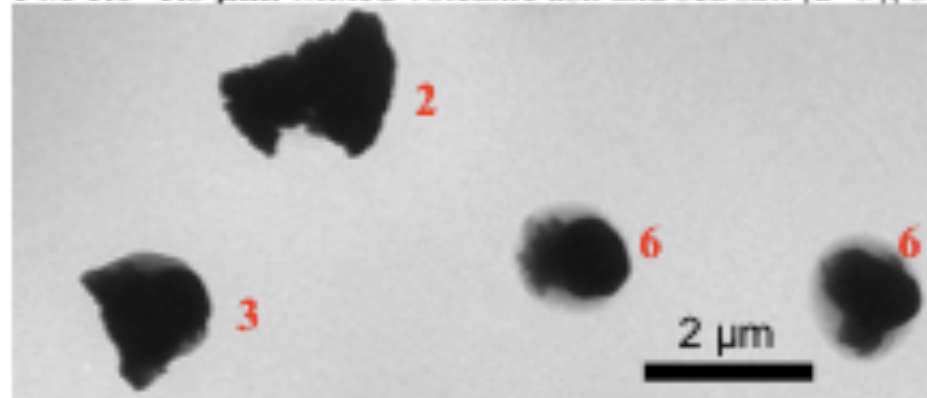
2-4 ash with sea salt

6 sea salt

PM 1.8–11 μm : Pure volcanic ash (1), mixed volcanic ash and sea

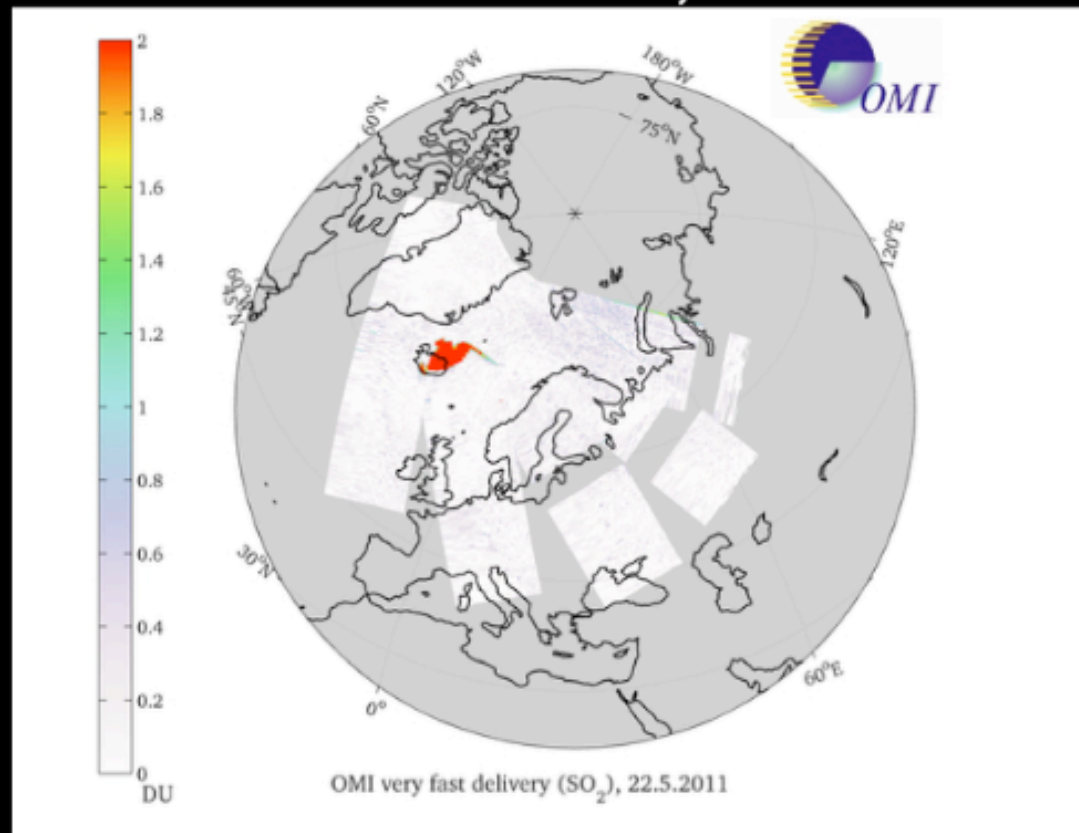


PM 1.0–1.8 μm : Mixed volcanic ash and sea salt (2–3), sea salt (6)

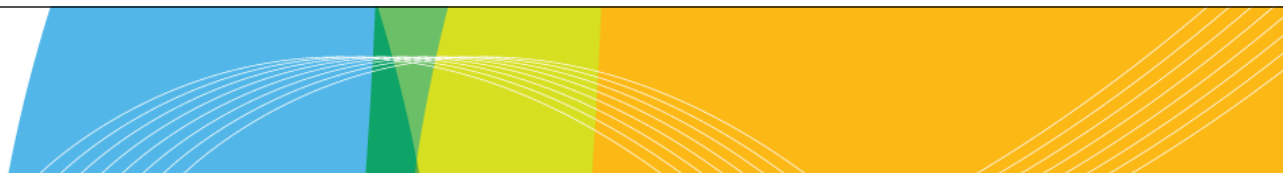




OMI SO₂ TRM, 22.05.

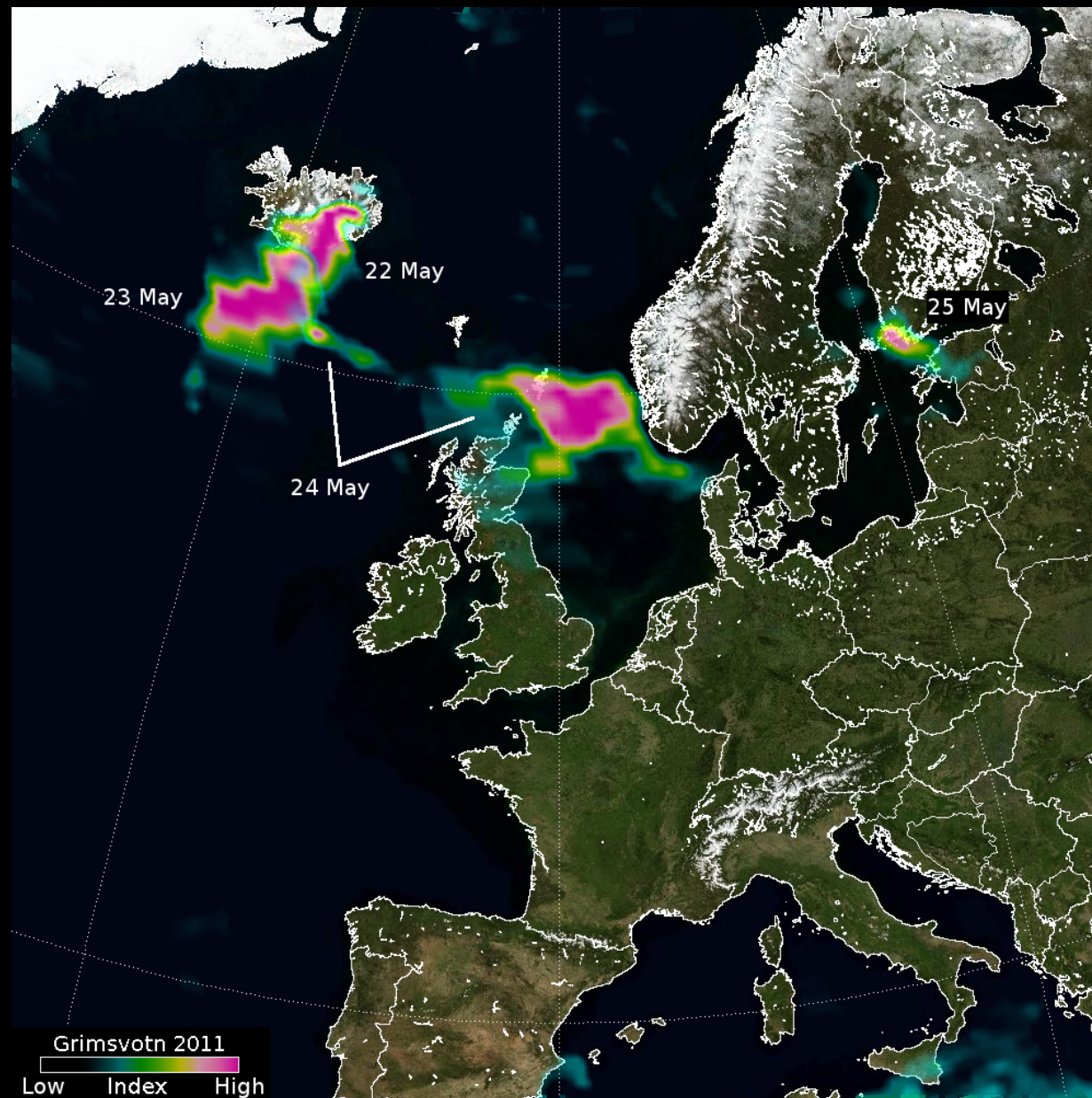


NASA / KNMI / FMI



Conclusions

- **OMI ash and SO₂ measurements were used to track and forecast the dispersion of the Grimsvötn volcanic plume**
- **The updated OMI Very Fast Delivery products of SO₂ and AAI were useful**
- **Volcanic plume arrived to Finland on May 25th and the air quality was decreased for about 8 hours in Southern Finland due to increased PM₁₀ concentrations.**
- **Combination of satellite measurements, dispersion model and detailed air quality measurements were used to characterize the pollution episode**



Courtesy NASA /
Colin Seftor, SSAI